REMARKS

Claims 1-3, 5, 7, 8, 10, 16-19, 25, 40, 49 and 50 remain pending in this application. In the Office Action dated August 8, 2006, Claims 40 and 50 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. 6,835,354 to Woods et al. ("Woods"). Claims 1-3, 5, 7, 16-19, 25 and 49 were rejected under 35 U.S.C. § 103 as being unpatentable over Woods in combination with U.S. 6,793,698 to Sanger et al. ("Sanger").

Claims 8 and 10 were found to be allowable if rewritten in independent form to include all the limitations of their base claims and any intervening claims. Claim 8 has been rewritten in independent form to include all the limitations of base Claim 1 and intervening Claim 5. With the entry of this amendment, it is believed that Claim 8 and Claim 10, which depends from Claim 8, are allowable.

Claim 40 has been amended to recite "a core reaction zone" that is "configured to conduct exothermic reactions including at least one of combustion, partial oxidation, autothermal reforming, water gas shift, preferential oxidation and combinations thereof," and to specify that "the innermost shell" of the plurality of nested shells "surround[s] the core reaction zone." Claim 40 has also been amended to specify that the streams of heated materials are each routed through "coaxial zones," and that "both the first exothermic reaction and the second exothermic reaction occur within the core reaction zone or the plurality of nested shells." Support for this amendment can be found in the Specification at, for example, page 4, lines 9-20.

Claim 50 has been amended to recite, inter alia, "at least four shells arranged concentrically about the outer wall of the core reaction zone," and "at least four fluid flows, each in a different coaxial zone." Support for this amendment can be found in the Specification at, for example, page 4, lines 9-20.

With the entry of these amendments, it is submitted that the rejections under § 102 for anticipation by Woods are overcome.[1] The feature of Woods that corresponds to the "core

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[1] Although the rejections of Claims 40 and 50 were made pursuant to 35 U.S.C. 102(b), applicants note that the cited Woods reference does not qualify as prior art under this subsection, since it was not issued or published more than one year prior to the filing date of the present application. The present application was filed on December 5, 2001, and claims priority to an application filed on May 30, 2001. The Woods reference was published on June 13, 2002 and issued on December 28, 2004. Similarly, the secondary Sanger reference was issued on

reaction zone" as defined by amended Claim 40 is the area inside shell 20 that includes the partial oxidation catalyst 30 and steam reforming catalysts 32 and 34. In the Office Action, the Examiner asserted that the first stream of heated material produced by the first exothermic reaction as recited in Claim 40 could include the flow of process gases through the catalysts beds 30, 32, 34 within the innermost shell 20 of Woods. However, with the entry of the present amendment, this interpretation is not consistent with the language of the claim, since Claim 40 now specifies that the first stream and the second stream of heated materials, produced by a first and second exothermic reaction respectively, are each routed through "coaxial zones" that surround the "core reaction zone," and cannot be interpreted to include the flow of process gases within the core reaction zone itself. Accordingly, the rejection of Claim 40 for anticipation by Woods is overcome.

With respect to Claim 50, Woods does not teach or suggest a reactor having "at least four shells arranged concentrically about the outer wall of the core reaction zone," and "at least four fluid flows, each in a different coaxial zone." The reactor discussed in Woods includes an inner shell 20 which corresponds to a core reaction zone, and outside of that a heat exchange wall 16, an inner steam generation heat exchange wall 54 and an outer steam generation shell 52, which define three coaxial zones surrounding the core reaction zone. Woods does not teach or suggest a reactor having at least four shells and at least four fluid flows, each in a different coaxial zone, as is recited in amended Claim 50. Accordingly, the rejection of Claim 50 for anticipation by Woods is overcome.

Turning now to the rejections under § 103, independent Claims 1, 25 and 49 were rejected as being obvious over Woods in combination with Sanger. Claim 1 recites a reactor that comprises, inter alia, a core reaction zone configured to conduct exothermic reactions; shells that are arranged coaxially about the core reaction zone; a gap being defined between each of the shells' walls to form a plurality of coaxial zones, the reactor being configured to permit heat transfer directly from one zone to another; and the reactor being configured so that hydrocarbon feed stock is preheated from about its storage temperature substantially to its desired preheat temperature by traversing a first zone, and an oxygen containing gas is preheated from about its

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September 21, 2004, which was after the filing date of the present application. Nevertheless, the applicants will address these references as if they were valid prior art, but do not concede that they are in fact prior art with respect to the present claims.

storage temperature substantially to its desired preheat temperature by traversing a second zone. In the Office Action, the Examiner acknowledges that the primary Woods reference fails to teach the limitation of "an oxygen containing gas being preheated form about its storage temperature substantially to its desired preheat temperature by traversing a second [coaxial] zone." However, the Examiner asserts this would have been obvious in view of the Sanger reference, which describes a reactor having an air preheat zone 130 on the outside of a reactor vessel.

The rejection of Claim 1 is traversed on the grounds that there would have been no teaching, suggestion or motivation for one of ordinary skill in the art to make the modifications proposed by the Examiner to arrive at the invention as claimed. It is a stated goal of Woods to use lower amounts of oxidant or air (see col. 4, lines 3-10), in order to attain higher fuel efficiencies. The air that is present in the reactor of Woods is pre-mixed with steam and fuel before it enters the reactor, the resulting mixture being heated in chamber 18 before entering the ATR. (The only other source of oxygen is within the waste gas from the fuel cell, which is mixed with fuel in a chamber 72 underneath the reactor and combusted in burner 78 without preheating or traversing a coaxial zone). Thus, one of ordinary skill would have no motivation to add a separate coaxial zone for preheating oxygen containing gas from about its storage temperature substantially to its desired preheat temperature, as is required by Claim 1, particularly since Woods teaches to minimize the amount of oxygen containing gas within the system.

Moreover, it is unclear how one would modify the system discussed in Woods to add a separate coaxial zone for pre-heating oxygen containing gas. If one were to simply add another coaxial shell for air and/or replace one of the existing zones with a zone for pre-heating air, it would change the thermal properties of the reactor in a potentially significant and unpredictable manner. One would have no motivation to do so, particularly since the Woods reactor purports to work well for its intended purpose. The modification proposed by the Examiner would require a substantial reconstruction and redesign of the Woods reactor, as well as change the entire principle of operation of the Woods reference, which indicates that one of ordinary skill in the art would not have any suggestion or motivation to make the proposed modification. See M.P.E.P. § 2143.01(VI) ("If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the reference are not sufficient to render the claims prima facie obvious.").

The reactor discussed in Woods is designed for a specific purpose: autothermal reforming of process gases using minimal air. Air is pre-mixed with fuel and steam to form a process gas mixture prior to entering the reactor. Associated "clean up" processes, including Water Gas Shift and CO polishing, are performed after the process stream leaves the reactor. (See Figs. 2 & 13). In present embodiment, oxygen containing gas and hydrocarbon feed stock are preheated in separate coaxial zones and can be used multiple purposes, e.g. for combustion in a burner, for reaction in an ATR. Further, thermal efficiencies gained by running various fluids through coaxial shells permits multiple steps of the reforming process to be performed in a single, compact unit. For example, in the embodiments shown in the present application, both autothermal reforming and a high-temperature shift reaction are performed in a single, compact unit. This is in contrast to the system described in Woods, where the shift reaction is performed in a separate unit outside of the reactor.

The deficiencies with respect to the primary Woods reference are not overcome by the secondary Sanger patent. Sanger discusses a different type of system than the reformers of both Woods and of the present invention. Sanger does not disclose nested shells forming a plurality of coaxial zones. In Sanger, the central reforming zone is insulated from the rest of the reactor (see 155 in Fig. 2) to prevent thermal transfer, which is entirely inconsistent with the present invention. Outside of the core reaction area, there are a plurality of combustors 195 spread throughout the system. A fuel/steam mixture flows through catalysts 220 surrounding each combustor, and not through a coaxial zone surrounding a core reaction zone. Furthermore, there is no zone in which a hydrocarbon feedstock (i.e. fuel) is pre-heated, as is specified in Claim 1. Rather, the fuel is pre-reformed in catalyst beds 220 as soon as it enters the reactor. There is an outer jacket 130 surrounding the entire system that is used to heat air. However, Sanger does not teach or suggest a plurality of coaxial zones, as is required by Claim 1. One skilled in the art would have no suggestion or motivation to combine the reactor of Sanger with the reactor of Woods to produce the present invention, since the reactors in these two references are so different, it would require a substantial reconstruction and redesign with no reasonable expectation that the resulting combination would work for its intended purpose. Accordingly, the rejections of independent Claim 1 and its dependents, Claims 2, 4, 5, 7 and 16-19, are all overcome.

With respect to independent Claim 25, the rejection of this claim as being obvious over Woods and Sanger is traversed for substantially the same reasons as the rejection of Claim 1. One of ordinary skill would have no teaching suggestion or motivation from the Woods and Sanger reference to provide the reactor as claimed, particularly where the reactor is "configured so that hydrocarbon feed stock is preheated in a second zone and an oxygen containing gas is preheated in a third zone." For the reasons described above, it is submitted that the rejection of Claim 25 is overcome.

Furthermore, for all the above-stated reasons, there would be no teaching, suggestion or motivation for the reactor as defined in Claim 49. Independent Claim 49 specifies that the reactor comprises "a first zone contain[ing] a catalyst selected from the group including a steam reforming catalyst and a shift catalyst; and the reactor being configured so that a hydrocarbon feed stock is preheated in a second zone, and an oxygen containing gas is preheated in a third zone." As previously discussed, this combination of features is not taught or suggested by the Woods and Sanger references.

Finally, the previously-noted deficiencies of the Woods reference with respect to amended Claims 40 and 40 are not overcome by the secondary Sanger reference. As already discussed, the Sanger reference relates to an entirely different type of reactor that does not include, for example, a plurality of coaxial zones surrounding a core reaction zone and in thermal contact with one another, as is recited in the claims.

Applicants respectfully renew the request for reconsideration of the Restriction Requirement dated 8, 2005, and rejoinder of the non-elected claims in this application. In particular, applicants request rejoinder of the claims corresponding to non-elected species a-1, which include, in addition to the claims dependent on allowable generic claims as previously discussed, Claims 20, 30-32 and 42-48. It is submitted that these claims are all allowable over the cited references for substantially the same reasons as pending Claims 1, 25, 40, 49 and 50.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

HAMILTON, BROOK, SMITH & REYNOLDS, P.C.

By _____

Kevin T. Shaughnessy
Registration No. 51,014
Telephone: (978) 341-0036
Facsimile: (978) 341-0136

Concord, MA 01742
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